

# **Willow Master Development Plan**

## **Appendix E.15**

### **Economics Technical Appendix**

January 2023

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# Memorandum

**Date:** April 20, 2022

**To:** Kristen Hansen, DOWL

**From:** Patrick Burden and Leah Cuyno

**Re:** Updated Economic Analysis of Proposed Alternatives for the Willow Master Development Plan Supplemental EIS

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DOWL requested Northern Economics to quantify the potential economic impacts of the proposed alternatives being considered for the Supplement to the Willow Master Development Plan (MDP) EIS. The supplemental analysis addresses deficiencies identified in the August 2021 U.S. District Court of Alaska decision to vacate the earlier Record of Decision and Final EIS by including an additional alternative that would provide ‘maximum protection’ to surface values in the Teshekpuk Lake Special Area (TLSA). This new action alternative would result in less infrastructure in the TLSA. The results of this updated economic impact analysis will be used to inform the environmental consequences section of the Supplemental EIS (SEIS).

This memorandum transmits the results of the updated economic impact analysis and describes the approach, assumptions, and data used in the analysis.

## **Scope of Analysis**

### ***Project Alternatives***

For the purpose of this quantitative analysis, the following action alternatives are analyzed-- Alternatives B, C, D, and E. Note that Alternative A, is the No Project alternative; no development will occur under this alternative and the existing or baseline economic conditions will continue.

**Alternative B** is the *Proponent’s Project* alternative. The alternative provides the shortest road access from the GMT Unit to the proposed Willow facilities.

**Alternative C** is described as the ‘*disconnected infield roads*’ alternative.

**Alternative D** is described as the ‘*disconnected access*’ alternative.

**Alternative E** is described as the ‘*Three-Pad Alternative*’.

The proposed development scenarios for Alternatives B, C, and D include 5 drill sites, and construction of processing facilities at the Willow Central Processing Facility (WCF), a Willow Operations Center (WOC), access roads, pipelines, an airstrip, and a gravel mine.

However, certain features, particularly with respect to location and access vary depending on the alternative. For example, Alternative C would not include a gravel road connection between the WCF and the three northern drill sites, BT1, BT2, and BT4. There would be no road bridge across Judy Creek. Instead, an annually-constructed ice road would provide seasonal ground access to these drill sites. Alternative C would require two WOCs and airstrips: a South WOC and airstrip near the WCF, and a North WOC and airstrip, near BT2.

Alternative D, on the other hand, considers a development in which the Plan Area does not have year-round gravel road access to GMTU and Alpine. Instead, the Plan Area would be accessible only by air, ice road, and limited low ground-pressure vehicle. Alternative D includes construction of an annual ice road from GMTU to the Plan Area. Alternative D retains gravel roads between Plan Area facilities for safety and spill response. Alternative D would require a new diesel pipeline to the WOC from the Kuparuk CPF2 and approximately 25 acres of additional gravel pad footprint at the WCF. The lack of flexibility to use existing North Slope infrastructure and associated constraints on construction and logistics would extend the construction phase, delay the first oil date, and affect operational efficiency and emergency response for the life of the development.

Alternative E is the additional alternative identified by the BLM and cooperating agencies to address the Alaska District Court's remand. Under this alternative, drill site BT4 will be eliminated, resulting in only 4 drill sites and a WCF to support the Willow Project. Additional features of this alternative include moving drill site BT2 to a location north of Fish Creek (BT2 North), expanding drill sites BT1 and BT2 to accommodate more wells, relocating drill site BT5 to the northeast location just outside of yellow-billed loon setback buffer, and eliminating the constructed freshwater reservoir.

More details on these different alternatives are provided in Chapter 2 of the SEIS document.

### ***Economic Indicators***

This analysis quantifies the potential economic effects or consequences of the Project alternatives with respect to the following economic indicators:

1. **Potential Revenues.** This analysis provides estimates of the following potential government revenue streams:
  - State of Alaska: Royalty Revenue, Property Tax, Production Tax, Oil Surcharge, Corporate Income Tax.
  - Federal Government: Royalty Revenue, Corporate Income Tax, Gravel sales
  - North Slope Borough: Property Tax

2. **Potential Employment.** This analysis provides estimates of the direct, indirect, and induced employment effects associated with the construction phase and operations phase of the proposed Project alternatives. Employment effects reflect the total number of average part-time and full-time jobs resulting from the proposed construction and production (operations) activities.
3. **Potential Labor Income.** This analysis provides estimates of the potential labor income effects associated with the construction phase and operations phase of the proposed Project alternatives.

## **Approach, Assumptions, and Data**

### ***Estimating Potential Revenues***

To quantify the potential streams of government revenues, the cash-flow model originally developed by the Alaska Department of Natural Resources (DNR) for evaluation of oil and gas projects in the Alaska North Slope was adapted and modified to reflect the Willow MDP SEIS project alternatives. The DNR model is based on the current fiscal regime and contains input cells that are fixed due to statutes or regulations; the major fiscal model parameters are shown in the table below.

**Table 1. Alaska Fiscal Model Parameters**

<b>Category</b>	<b>Definition (Alaska Statute)</b>	<b>Value</b>
<b>Conservation Surcharges (\$/barrel)</b>	43.55.201, 43.55.300	\$0.05
<b>North Slope Oil Tax</b>	—	—
Production Tax Rate on PTV	43.55.011 (e)	35%
\$/BOE QCE exclusion (\$/barrel)	43.55.165 (e)(18)	\$0.30
Overhead allowance for lease expenditures	43.55.165 (a)(2), 15 AAC 55.271	4.5%
<b>Minimum tax</b>	—	—
Minimum Gross Tax (applied on GVPP)	43.55.011 (f)	4.0%
<b>Oil and Gas Property Tax</b>	—	—
Property Tax Rate	43.56.010	2.0%
<b>Gross Value Reduction on "New Oil"</b>	—	—
GVR %	43.55.160 (f)	20.0%
Additional GVR % (New field, ROY>12.5%)	43.55.160 (f &g)	30.0%
GVR Year Limit	43.55.160 (f)	7
GVR Oil Price limit: 3 years with ANS price above	43.55.160 (f)	\$70.00
<b>State and Federal Income Tax</b>	—	—
State Income Tax	—	9.40%
Federal Income Tax	—	21.00%

The major inputs and assumptions used in the model to reflect the proposed project include:

### **1. Capital Expenditures (CAPEX)**

Over the last 10 years Northern Economics, Inc. (NEI) has been working on various development projects in the North Slope, to estimate the effects of oil and gas development on local communities, regional entities, and the State of Alaska. As part of

these projects, NEI has obtained cost information from company specific projects as well as from surveys of operating companies and businesses in the oil and gas support services sector.

The facility CAPEX estimates presented in this memorandum are based on data from five proprietary project CAPEX estimates that had central processing facilities. The CAPEX estimates were adjusted to fit the specification required by the DNR cash-flow model, and a linear regression equation for CAPEX was developed based on total volume of oil and natural gas liquids (NGLs) produced over the life of the field, and whether the project had seasonal access. The regression equation has the form of Seasonal Access (1 if seasonal access, 0 if year-round access) \* 1015.96 + million barrels of oil and NGLs produced (MMBO) \* 0.656946 + 4306.702. The equation has a coefficient of determination ( $r^2$ ) of 0.60.

Drilling CAPEX was estimated using the same variables as the facility CAPEX. The drilling regression equation has the form of Seasonal Access (0,1) \* 152.8 + MMBO \* 1.30049 + 2875.411. The equation has a coefficient of determination ( $r^2$ ) of 0.72.

The estimated drilling and facilities capital expenditures are shown in the table below.

**Table 2. Estimated Capital Expenditures by Alternative, in millions of 2021 \$**

Capital Expenditure Item:	Alternatives B	Alternative C	Alternative D	Alternative E
Drilling	\$3,914	\$4,270	\$4,331	\$3,893
Facilities	\$4,832	\$5,847	\$5,935	\$4,821
<b>Total:</b>	<b>\$8,746</b>	<b>\$10,118</b>	<b>\$10,267</b>	<b>\$8,714</b>

Source: Northern Economics estimates.

## 2. Operating Expenditures (OPEX)

The OPEX regression equation has the form of MMBO \* 0.039407392 + 4515.887379. Alternatives C and D have higher operating costs than Alternative B and E due to the additional costs of providing seasonal access and operating additional facilities.

The estimated total cumulative operating expenditures amount to \$4.547 billion for Alternative B, \$4.774 billion for Alternative C, \$4.843 billion for Alternative D, and \$4.546 billion for Alternative E.

## 3. Crude Oil Price Forecasts

Two oil price projections were used in this analysis to provide a range of estimates for the potential revenue effects— 1) the latest U.S. Energy Information Administration (EIA) oil price projections published in the *Annual Energy Outlook 2021* on February 3, 2021, and 2) the latest Alaska Department of Revenue (ADOR) oil price projections published in the *Revenue Sources Book Fall 2021* on December 24, 2021.

The ADOR oil price forecast (for ANS West Coast) reflects a more conservative price forecast (at \$60.66 per barrel in real 2021\$, average over 2022 to 2031 period) while the

EIA price forecast reflects a higher oil price scenario (at \$80.33 per barrel in real 2021\$, average over 2022 to 2050). The ADOR forecast is a 10-year forecast through 2029 and the EIA forecast is through year 2050. Prices beyond the timeframe published were extrapolated using the cumulative annual growth rate provided in the 10-year forecast.

#### **4. Netback Costs: Tariffs/Transportation Costs**

For royalty calculations, oil is valued at the wellhead, hence, netback costs which include marine transportation cost, quality adjustment, TAPS tariff, and pipeline and feeder line tariffs, are deducted from the projected market price. Estimates of netback costs used in this analysis are from the Alaska Department of Revenue's *Revenue Sources Book Fall 2021*; except for the feeder line tariff data which was obtained from the Alaska Department of Natural Resources, Division of Oil and Gas.

#### **5. Projected Annual Production Volumes**

The table below shows the total projected oil production under each alternative. All Alternatives have a 25-year production life. Oil production for Alternatives B, C, and E begin in Year 6 of the project life, while first oil production for Alternative D starts in Year 7.

**Table 3. Annual Production Volumes in millions of barrels of oil (MMBO)**

Year	Alternative B	Alternative C	Alternative D	Alternative E
6	60.39	60.39	0.00	60.31
7	66.48	66.48	60.39	66.88
8	59.30	59.30	66.48	60.18
9	52.58	52.58	59.30	51.74
10	46.40	46.40	52.58	45.67
11	41.10	41.10	46.40	39.43
12	36.92	36.92	41.10	35.38
13	33.28	33.28	36.92	31.20
14	29.85	29.85	33.28	27.83
15	26.74	26.74	29.85	25.24
16	24.21	24.21	26.74	23.06
17	21.50	21.50	24.21	20.93
18	19.07	19.07	21.50	18.62
19	16.23	16.23	19.07	15.96
20	14.19	14.19	16.23	13.93
21	12.32	12.32	14.19	11.98
22	10.93	10.93	12.32	10.47
23	9.68	9.68	10.93	9.27
24	8.77	8.77	9.68	8.31
25	8.07	8.07	8.77	7.57
26	7.46	7.46	8.07	6.94
27	6.32	6.32	7.46	5.87
28	6.19	6.19	6.32	5.82
29	5.66	5.66	6.19	5.22
30	5.23	5.23	5.66	4.84
31	0.0	0.0	5.23	0.0

Source: CPAI, 2022.

### ***Estimating Employment and Income Effects***

Direct manpower requirements for the Willow MDP were estimated by CPAI and presented in the results section below. The potential indirect and induced employment and income effects for this analysis were estimated using the IMPLAN model of the Alaska economy. The IMPLAN model is an input–output model that is commonly used in economic impact studies to measure the multiplier effects/stimulus effects of an economic development project.

The estimates of industry spending on capital expenditures (CAPEX; construction costs) and on operating expenditures (OPEX) for each of the project alternatives, as described above, were used as inputs for the model. The IMPLAN model provides estimates of the number of part-time and full-time indirect and induced jobs required to meet the increase in demand for goods, materials, and services during the construction and the operations phases of the proposed project. These indirect and induced jobs (and associated income) are considered the multiplier effects or stimulus effects that result from the increase in demand in various industries/sectors in the Alaska economy, particularly those that support the construction sector, and the oil and gas extraction/production sector (indirect effects), as well as all the other sectors that provide goods and services to the industry workers (induced effects).



The IMPLAN model provides estimates of indirect and induced labor income based on information on average Alaska wages and salaries in the various sectors of the economy. Prevailing annual average wages for oil and gas jobs are presented below.

## **Results**

### ***Projected Government Revenues***

The Willow MDP is projected to generate revenues to the federal government, the State of Alaska, and the North Slope Borough from royalties, taxes, and other fees. The projected revenues by revenue stream and by Alternative are presented in the table below. The values shown in the table reflect the estimated total cumulative revenues through the end of the production life of the field.

**Table 4. Estimated Potential Revenues of the Willow MDP SEIS Alternatives**

Revenue Category	Alternative B		Alternative C		Alternative D		Alternative E	
	DOR Price	EIA Price	DOR Price	EIA Price	DOR Price	EIA Price	DOR Price	EIA Price
<b>State of Alaska</b>								
Royalty Revenue	\$2,329.9	\$3,662.3	\$2,329.9	\$3,662.3	\$2,301.5	\$3,701.2	\$2,270.0	\$3,560.1
Property Tax	\$103.7	\$103.7	\$124.3	\$124.3	\$133.7	\$133.7	\$101.4	\$101.4
Production Tax	\$393.0	\$3,622.9	\$404.1	\$3,273.5	\$385.4	\$3,593.2	\$374.3	\$3,399.1
Oil Surcharge	\$26.2	\$26.2	\$26.2	\$26.2	\$26.2	\$26.2	\$25.5	\$25.5
Corporate Income Tax	\$833.2	\$1,781.8	\$677.3	\$1,659.7	\$630.1	\$1,644.0	\$783.0	\$1,711.1
<b>Total:</b>	<b>\$3,686.0</b>	<b>\$9,196.9</b>	<b>\$3,561.8</b>	<b>\$8,746.1</b>	<b>\$3,477.0</b>	<b>\$9,098.4</b>	<b>\$3,554.2</b>	<b>\$8,797.3</b>
<b>Federal Government</b>								
Royalty Revenue	\$2,329.9	\$3,662.3	\$2,329.9	\$3,662.3	\$2,301.5	\$3,701.2	\$2,270.0	\$3,560.1
Corporate Income Tax	\$1,726.9	\$3,646.8	\$1,411.3	\$3,399.8	\$1,315.8	\$3,368.0	\$1,625.3	\$3,503.8
Gravel sales	\$9.9	\$9.9	\$9.9	\$9.9	\$9.9	\$9.9	\$9.9	\$9.9
<b>Total:</b>	<b>\$4,066.7</b>	<b>\$7,319.0</b>	<b>\$3,751.1</b>	<b>\$7,072.0</b>	<b>\$3,627.2</b>	<b>\$7,079.1</b>	<b>\$3,905.2</b>	<b>\$7,073.8</b>
<b>North Slope Borough</b>								
Property Tax	\$1,278.6	\$1,278.6	\$1,533.2	\$1,533.2	\$1,649.3	\$1,649.3	\$1,250.1	\$1,250.1

Source: Northern Economics estimates.

At the State level, there are several potential sources of revenues that would be generated from the proposed development. Production from the Willow development would result in royalties paid to the federal government, and State of Alaska would receive 50 percent of those royalties. The federal royalty rate is 16.67 percent of the wellhead value. Total estimated cumulative state royalties range from \$2.27 billion to \$3.70 billion.

The state would receive property tax payments on onsite facilities and these revenues would start accruing during the construction phase. Total State property tax revenues are projected to range between \$101 million and \$134 million, depending on the Alternative.

Oil produced and sold from lands within Alaska are subject to a severance tax as the resources leave the land. This severance tax is commonly referred to as the “production tax.” The production tax applies to oil produced from any area within the boundaries of

the state, including lands that are owned by the state, the federal government (like NPR-A), or private parties, such as Native corporations. Severance tax or production tax payments are based on the current tax rate of 35 percent of the production value, which is the value at the point of production, less all qualified lease expenditures (net value). Qualified lease expenditures include certain qualified capital and operating expenditures. Total production taxes are estimated to range from \$374 million to over \$3.6 billion, depending on the oil price assumption and the Alternative.

An oil and gas corporation's Alaska income tax liability depends on the relative size of its Alaska and worldwide activities and the corporation's total worldwide net earnings. State corporate income tax is calculated as 9.4 percent of the Alaska share of worldwide income for each corporation. The ADNRR model, however, does not take into consideration corporate worldwide income (which is unknown at this time) but simply evaluates all the costs and revenues and the resulting state income tax given the 9.4 percent income tax rate. Total estimated state corporate income tax payments could range between \$630 million and \$1.78 billion, depending on the Alternative and oil price assumption. In addition, the state would also receive oil surcharge revenues estimated to amount to about \$26 million. Conservation surcharges apply to all oil production in Alaska and are in addition to oil and gas production taxes. Revenues derived from these surcharges are intended to be used for oil and hazardous substance release prevention and response.

At the Federal level, projected federal royalty revenue, corporate income taxes, and gravel royalties could amount to between \$3.63 billion and \$7.3 billion (total through the entire economic life of the field).

At the regional level, the NSB government is anticipated to benefit from property tax revenues. The property tax would be based on the assessed valuation of the facilities developed onsite. The annual levy is based on the full and true value of property taxable under AS 43.56. For production property, the full and true value is based on the replacement cost of a new facility, less depreciation. The depreciation rate is based on the economic life of proven reserves. Pipeline property is treated differently; it is valued on the economic value of the property over the life of the proven reserves. The State property tax rate is 20 mills. A local tax is levied on the state's assessed valued for oil and gas property within a city or borough and is subject to local property tax limitations. The current tax rate for the NSB is 18.5 mills (hence, the state portion of the property tax is 1.5 mills). Property tax payments would start to accrue during the construction phase. Total cumulative NSB property tax revenues are estimated to amount to between \$1.25 billion and \$1.65 billion, depending on the Alternative.

The City of Nuiqsut could also potentially benefit from higher bed tax revenues from higher hotel occupancy during the initial construction years while mobilization of construction equipment is occurring and even during operations. The City of Nuiqsut

currently has a 12 percent bed tax. The change in the level of hotel occupancy however is difficult to quantify at this point because the timing and level of activities are uncertain and may vary. The City also has a tobacco tax that could generate additional revenues for the City. Furthermore, the City of Nuiqsut would be eligible to receive funds through the NPR–A Impact Mitigation Grant Program, which is funded by royalty and other revenues from leases in the NPR–A. As noted above, production from the Willow development is anticipated to generate royalties that would significantly increase funds for the NPR–A Impact Mitigation Grant Program.

### ***Projected Employment and Income Effects***

Table 5 presents the estimated direct manpower requirements during the construction phase for both the Proponent’s Proposed Alternative (Alternative B) and Alternative E (the additional alternative being considered in the SEIS). These jobs will be required on the project site in the North Slope. Peak construction employment for both Alternatives is anticipated to occur in Year 4 of the project schedule with about 1,650 jobs (seasonal peak) jobs under Alternative B and about 1,700 jobs (seasonal peak) under Alternative E. The jobs created during the construction phase would be temporary, with some activities only occurring over several months (i.e., ice road construction). Given Alternative E’s reduced infrastructure, the construction phase is expected to be shorter, lasting 8 years compared to 10 years under Alternative B.

Drilling activities are planned to occur over a period of 7 years starting in Year 5. Under Alternative E, drilling activities would require 390 annual average jobs in the North Slope from Year 5 through Year 8, and reduced to 195 jobs for the remaining 3 years of drilling (Year 9 to 11). Under Alternative B, 390 annual average jobs would be required from Year 5 through Year 10, then reduced to 99 jobs on the last year of drilling (Year 11). North–Slope based workers would be on a 2–week rotation so the number of workers on–site would be half of the numbers noted above. Drilling activities would also require 10 year–round jobs based in Anchorage.

Direct construction and drilling activities would also support on average about 3,000 indirect and induced part–time and full–time jobs per year in other sectors of the state’s economy over the construction phase (under Alternatives B). Alternatives C and D would result in slightly higher indirect and induced jobs (about 3,500 and 3,900, respectively), mainly due to the higher estimated construction spending on additional facilities and logistics, while Alternative E is projected to result in about 2,900 indirect and induced jobs.

**Table 5. Estimated Number of Direct Construction Jobs**

Year	Proponent’s Proposed Alternative		Alternative E	
	Seasonal Peak	Annual Average	Seasonal Peak	Annual Average
1	40	26	40	26
2	200	130	200	130

Year	Proponent's Proposed Alternative		Alternative E	
	Seasonal Peak	Annual Average	Seasonal Peak	Annual Average
3	750	488	750	488
4	1,650	1,073	1,733	1,127
5	1,500	975	1,650	1,073
6	950	618	950	618
7	350	228	350	228
8	100	65	100	65
9	100	65	–	–
10	100	65	–	–

Source: CPAI, 2022.

During the operations phase, Alternative E is projected to generate the same number of direct O&M jobs as the Project Proponent's Alternative as shown in Table 6. The project is estimated to support 25 year-round jobs based in Anchorage during the operations phase of the project. The North Slope based job numbers shown in the table are the estimated number of workers required for O&M activities assuming a 2-week rotation. The number of workers onsite at any given time would be half of the number shown in each year in the table above (CPAI, 2022). These operations and maintenance jobs would mostly be year-round but there will be some jobs associated with production activities that will also be seasonal in nature.

**Table 6. Estimated Number of Direct O&M Jobs: Proponent's Project Alternative and Alternative E**

Year	Slope Based	Anchorage Based
6	100	25
7	275	25
8	400	25
9+	425	25

Source: CPAI, 2022.

In addition to the direct jobs, annual operations and maintenance activities are estimated to create an additional 360 to 400 indirect and induced jobs per year.

These estimated jobs are available for workers residing in the North Slope, other areas of Alaska, and outside Alaska. It is unknown at this time how many workers from North Slope communities and other Alaska communities would participate in the direct oil and gas activities. According to the Alaska Department of Labor and Workforce Development, over the past decade, the share of oil industry workers who are not Alaska residents has grown, ranging from 31 percent nonresident in 2010 to 35 percent in 2020. This percentage of non-resident workers could change in the future, depending on availability of training programs and labor supply.

Oil field development projects in the North Slope typically require specialty tradesmen and construction workers with the skills and experience in ice roads, pipeline construction, facilities construction, and drilling; and these jobs are typically held by non-local workers. However, opportunities do exist for North Slope residents that live

near existing oil developments. Local residents have participated in oil and gas jobs such as ice road monitors, camp security and facilities operators, and subsistence representatives. The Alaska Department of Labor and Workforce Development and the oil and gas industry have training programs geared towards developing special skills required in oilfield services. This is expected to create more employment opportunities for local residents.

Table 7 shows the prevailing average yearly earnings of workers in various industries in Alaska that are associated with the direct construction and operations jobs described above. The table shows that direct oil and gas industry jobs currently pay about \$170,000 per year; and the oil and gas extraction sector paying even more at approximately \$242,000 per year.

Note that a direct oil and gas industry worker either works for an oil producer or an oilfield service company. Thousands of other jobs that directly serve the oil and gas industry but are not categorized under this sector are generally included in the Support Activities for Mining sector; some of these jobs are in security, catering, accommodations, transportation, and logistics services.

Indirect and induced jobs, on the other hand, would be jobs in a variety of other sectors of the Alaska economy that provide goods and services to the oil and gas industry and its direct workers. The projected annual average earnings associated with these indirect and induced jobs are estimated to be about \$60,500.

**Table 7. Prevailing Statewide Average Annual Earnings by Selected Industries associated with the Direct Construction and Operations Jobs**

Industry	Average Annual Earnings
Oil and Gas Industry	\$169,632
Oil and Gas Extraction	\$242,160
Support Activities for Mining	\$119,268
Construction (industry-wide average)	\$82,356
Construction of Buildings	\$76,428
Heavy Construction	\$110,748
Specialty Trade Contractors	\$71,052

Source: QCEW 2020 data, ADOLWD, 2022.

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